

CLAIMS

1. A different shaft type rack-assisting type electric power steering apparatus, in which an auxiliary steering torque is generated by an electric motor in accordance with a steering torque impressed upon a steering wheel and transmitted to a rack shaft of a steering mechanism via a power transmission mechanism, the power transmission mechanism including:
 - 10 an external gear of which diameter is small, which is driven by the electric motor and has external teeth;
 - a ring-shaped internal-external gear, which has internal teeth inscribed and meshed with the external gear, is swingably supported around an axis of the external gear,
 - 15 and an outer circumferential face of which acts as a drive side pulley;
 - a driven side pulley driven by the internal-external gear via a belt; and
 - a ball screw mechanism driven by the driven side pulley so as to move the rack shaft,
 - 20 wherein a circular support body is substantially concentrically provided at an end portion of the external gear; and
 - an annular support body, which supports the circular support body, is substantially concentrically provided at

an end portion of the internal-external gear so as to be inscribed with the circular support body.

2. The electric power steering apparatus according
5 to claim 1, wherein an outer diameter of the circular support body is set substantially the same as a pitch circle diameter of the internal teeth of the external gear, and

an inner diameter of the annular support body is set
10 substantially the same as a pitch circle diameter of the internal teeth of the internal-external gear.

3. The electric power steering apparatus according
to claim 1, wherein the circular support body and the
15 annular support body respectively has a movement regulating mechanism for regulating a movement of the internal-external gear in the axial direction.

4. The electric power steering apparatus according
20 to claim 3, wherein an outer diameter of the circular support body is set substantially the same as a pitch circle diameter of the external gear, and
an inner diameter of the annular support body is set
25 substantially the same as a pitch circle diameter of the internal teeth of the internal-external gear.

5. The electric power steering apparatus according
to claim 3, wherein in the movement regulating mechanism,
shape of contact portions, in which the circular support
5 body contacts with the annular support body, are formed in
such a manner that one is formed into a protruding shape
and the other is formed into a recessing shape.

6. The electric power steering apparatus according
10 to claim 3, wherein in the movement regulating mechanism,
shape of contact portions, in which the circular support
body contacts with the annular support body, are formed in
such a manner that both are formed into tapered shape,
opposed to each other and symmetrically to each other.

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7. The electric power steering apparatus according
to claim 1, wherein a flange is provided on a side of the
internal-external gear.

20 8. The electric power steering apparatus according
to claim 7, wherein the flange is formed integrally with
the annular support body, which is provided at an end
portion of the internal-external gear.

9. The electric power steering apparatus according to claim 1, wherein external teeth of the external gear, internal teeth of the internal-external gear, outer circumferential face engagement teeth of the internal-
5 external gear, engagement teeth of the belt and outer circumferential face engagement teeth of the driven side pulley are respectively set to be oblique teeth, and
twist directions of these oblique teeth are set to be in the same direction.

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10. The electric power steering apparatus according to claim 9, wherein

twist angle of the internal tooth of the internal-
external gear is set θ_a ,

15 twist angle of the outer circumferential face engagement tooth of the internal-external gear is set θ_b ,
pitch circle radius of engagement of the internal tooth of the internal-external gear is set r_a , and
pitch circle radius of engagement of the outer circumferential face engagement tooth of the internal-
20 external gear with the engagement tooth of the belt is set r_b ,

wherein θ_a , θ_b , r_a and r_b are set so as to satisfy following relation.

25 (Formula 4)

$$(r_b / r_a) = (\tan \theta_b / \tan \theta_a)$$

11. The electric power steering apparatus according to claim 1, wherein the electric power steering apparatus 5 is used for steering rear wheels in a four wheel steering system.

12. The electric power steering apparatus according to claim 1, wherein the electric power steering apparatus 10 is used for a steer-by-wire type steering system in which the steering wheel and the rack shaft are not mechanically connected to each other.